2019 UDOT RESEARCH PROBLEM STATEMENT

*** ***Problem statement deadline is Feb. 6, 2019. Submit statements to UTRAC@utah.gov.*** ***

Title: Utilizing archived traffic signal performance measures for pedestrian planning & analysis – Phase II: Extending pedestrian volume estimation capabilities to unsignalized intersections **No. (Office Use):** 19.05.04

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Select ONE Subject Area ☐ Materials/Pavements ☐ Maintenance ☐ Traffic Mgmt/Safety ☐ Structures/Geotech ☒ Planning ☐ Perf Mgmt/Data Analytics ☐ Public Transportation ☐ Other

1. Describe the problem to be addressed:

There are two primary motivations for this work. *First*, multimodal transportation planning, traffic safety analyses, and health impact assessments require information on how many people walk in various locations throughout the day. Unfortunately, traditional data collection methods for levels of pedestrian activity are insufficient for these purposes. Manual counts on intersection or street segments are time consuming and often infeasible to conduct over long periods of time. Instruments such as infrared counters can record continuous data on trail users, but they are costly to deploy across multiple locations. Video-based pedestrian data collection methods via computer image processing are promising, but video cameras are also costly to install everywhere in a network.

Phase I of this research explored the use of a novel pedestrian data source that is relatively ubiquitous in both time and space (available 24/7 at many intersections): pedestrian push-button actuations recorded in high-definition data logs from traffic signal controllers and archived via the Automated Traffic Signal Performance Measures (ATSPM) system. The Phase I project compared pedestrian traffic signal actuation data to observed pedestrian counts and developed factoring methods to accurately predict pedestrian volumes at signalized intersections in Utah. While useful for estimating levels of walking activity at signalized intersections, the products of the Phase I research (currently) cannot be directly applied to unsignalized intersections.

Second, local and regional planning efforts are starting to require (and would benefit from) forecasts of pedestrian volumes and activity levels. Current travel forecasting methods are often based on household travel surveys, which may capture some walking trips as part of households' diaries. However, these methods provide estimates only at the traffic analysis zone (TAZ) level and are difficult to reliably disaggregate forecasts of walking activity down to the finer geographic level of individual intersections or segments.

Instead, some "direct demand" models have been developed to directly estimate site-specific pedestrian travel as a function of local land uses and transportation system characteristics. While useful for predicting pedestrian volumes now and into the future, these direct demand methods require a large quantity of estimation data in order to be applicable to many different locations beyond where they were estimated (usually for only a handful of intersections).

This research project addresses these two needs by developing large-scale direct demand models for estimating intersection-level pedestrian volumes, utilizing the ubiquitous pedestrian actuation data at signalized intersections from UDOT's ATSPM system. The project extends pedestrian activity prediction capabilities from signalized intersections to all intersections in Utah. It also develops models of intersection pedestrian volumes that can be applied in a forecasting sense, thus offering improved opportunities for pedestrian planning and operations.

2. Write the project objective (25 words or less):

To develop methods and models predicting pedestrian volumes at unsignalized intersections, based on ATSPM data and previously estimated models at signalized intersections.

3. Explain why this research is important:
(In response, consider addressing specific UDOT goals, applicability in Utah or other states, etc.)

This research will enrich the transportation planning process and contribute towards improved planning outcomes, particularly for active transportation and pedestrian planning. Many planning tasks require (or would benefit from) estimates of walking activity for various locations in the multimodal transportation network: prioritizing off-street infrastructure or sidewalk infill projects, planning for Safe Routes to School, considering crossing treatments, etc. Pedestrian volumes are also needed as measures of

exposure for pedestrian safety analyses and as measures of physical activity levels for health impact assessments. By developing models that make use of archived and real-time traffic signal data, this project creates validated methods for estimating pedestrian volumes at signalized and unsignalized intersections that are particularly useful for UDOT's and regional/local agencies' transportation planning efforts.

Additionally, this research will support UDOT's mission of "enhancing quality of life," strategic goal of "optimizing mobility," and emphasis areas of "integrated transportation" and "innovation," as well as Carlos' Top Ten goal of having "real-time full situational awareness" of the multimodal transportation system. Developing the models that may eventually provide validated estimates of real-time pedestrian volumes at many signalized and unsignalized intersections throughout Utah allows UDOT the ability to monitor use of the transportation system for non-motorized, active road users. This thus enhances UDOT's situational awareness and responsiveness as well as the ability to optimize operations to facilitate mobility for people walking and integrate pedestrian travel with other modes in planning and operations. Improved pedestrian planning capabilities can also orient planning efforts around improving safety and health, thus enhancing quality of life. Finally, this research will continue to position UDOT as an innovative leader in the utilization of traffic signal data for multiple purposes, including pedestrian planning.

4. List the major tasks:

1. Estimate pedestrian volumes at signalized intersections in Utah by applying the factoring methods developed in Phase I to ATSPM data from traffic signal controllers. Assemble observed pedestrian counts for the sample of signalized intersections that were studied in Phase I.
2. Assemble and prepare geospatial information about signalized and unsignalized intersections in Utah. This information will likely include local land use and built environment characteristics (e.g., residential density, businesses, schools, parks) as well as measures of the adjacent multimodal transportation system (e.g., transit service, traffic volumes).
3. Estimate models predicting pedestrian volumes at signalized intersections as a function of land use, built environment, and transportation system characteristics. Models will be appropriate for the data (e.g., negative binomial, multilevel) and will account for spatial autocorrelation; they could include some temporal aspects (e.g., weekday, season) as well. Different specifications may be utilized to examine the sensitivity of model accuracy to varying data inputs (e.g., only predictable built environment measures) and spatial units (e.g., quarter-mile buffers).
4. Apply estimated models to unsignalized intersections to predict pedestrian volumes at signalized and unsignalized intersections in Utah. Validate models and estimated pedestrian volumes.
5. Develop a prototype online tool and graphical interface to visualize estimated pedestrian volumes at signalized and unsignalized intersections. The tool could include some temporal dynamics to show pedestrian volumes at different days of the week or seasons of the year. For instance, it may be able to generate a "heat map" of walking activity.
6. Prepare a final report, presentation, and webinar summarizing the project.

5. List the expected deliverables (reports, manual, specification, design method, training, etc.):

1. Final project report, detailing the methods/models developed to estimate intersection pedestrian volumes.
2. Presentation and recorded webinar, summarizing the research project and the methods/models developed.
3. Prototype online tool and visualization, displaying estimated intersection pedestrian volumes.

6. Describe how the research results will be implemented:
(In response, consider addressing UDOT leader support, process or standard improvement, etc.)

This research will include a sample implementation through the development of a prototype online tool and graphical interface to visualize estimated pedestrian volumes at signalized and unsignalized intersections. The prototype will be designed to facilitate potential future integration with existing internal UDOT traffic signal data management and planning processes, such as the ATSPM system, although complete integration is beyond the scope of this project. Full implementation of these methods will be greatly eased by the products of this research.

Specifically, the final report will detail the methods and models developed to estimate pedestrian volumes at unsignalized intersections as a function of local land use and transportation characteristics as well as pedestrian actuation data from nearby and similar signalized intersections (via ATSPM). It will also include the steps used to apply the models and visualize them in an interactive manner, including any scripts or codes developed as part of the model application or prototype visualization process. This information can be used by UDOT staff or consultants to develop computerized data management and website

implementations of the intersection pedestrian volume estimation process for internal and/or public-facing efforts with respect to pedestrian planning, safety, and/or health analyses.

This research is broadly implementable to intersections and transportation agencies in all geographic areas of Utah, including all UDOT regions. It also helps to forge stronger connections and collaborations between UDOT divisions, including Planning, Traffic Management, and Traffic & Safety. This research may also have relevance to agencies in other states, who may be able to borrow the methods and models developed in this research project to utilize pedestrian signal actuation data for improved pedestrian planning in their own jurisdictions.

7. Requested from UDOT: $50,000 **Other/Matching Funds:** $0 **Total Cost:** $50,000
(or UTA for Public Transportation)

8. Outline the proposed schedule, including start and major event dates:

This research is anticipated to take approximately 18 months to complete, according to the following schedule:

2019	Jul–Aug:	Meet with technical advisory committee to refine scope, timeline, and deliverables.
	Sep–Dec:	Estimate pedestrian volumes and assemble observed pedestrian counts at signalized intersections (using models and data from Phase I). Assemble and prepare geospatial information about signalized and unsignalized intersections in Utah.
2020	Jan–Jun:	Estimate models predicting pedestrian volumes at signalized intersections.
	Mar:	Prepare interim report and receive feedback from technical advisory committee.
	May–Aug:	Apply estimated models to predict pedestrian volumes at unsignalized intersections.
	Jul–Nov:	Develop a prototype online tool and graphical interface to visualize estimated pedestrian volumes.
	Oct–Nov:	Prepare a draft report, website, guidebook, and presentation summarizing the project's results and the example application. Receive feedback from technical advisory committee.
	Dec:	Revise and submit final project report, presentation and recorded webinar, and prototype online tool.

Note: This Phase II project will make use of the results from a current UDOT project, 18.602: "Utilizing archived traffic signal performance measures for pedestrian planning & analysis." That Phase I project is developing methods to take pedestrian actuation data and estimate the actual number of people walking at an intersection, by developing methods to validate push-button actuations (from ATSPM signal controller logs) with observed pedestrian counts. This proposed research extends these capabilities at signalized intersections to unsignalized intersections throughout Utah.